Supplementary Material

Large-scale drivers of the exceptionally low winter Antarctic Sea Ice Extent in 2023

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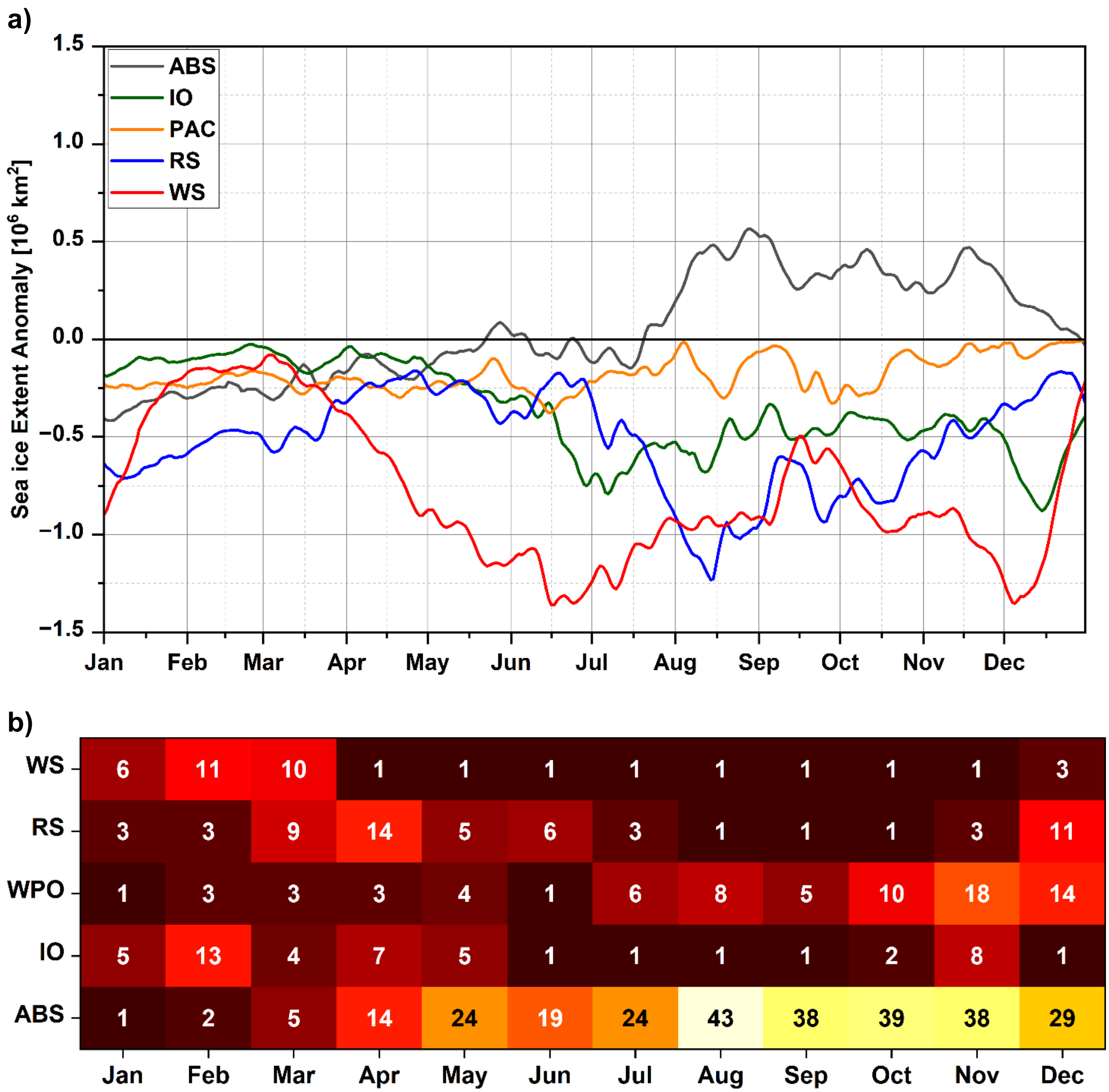
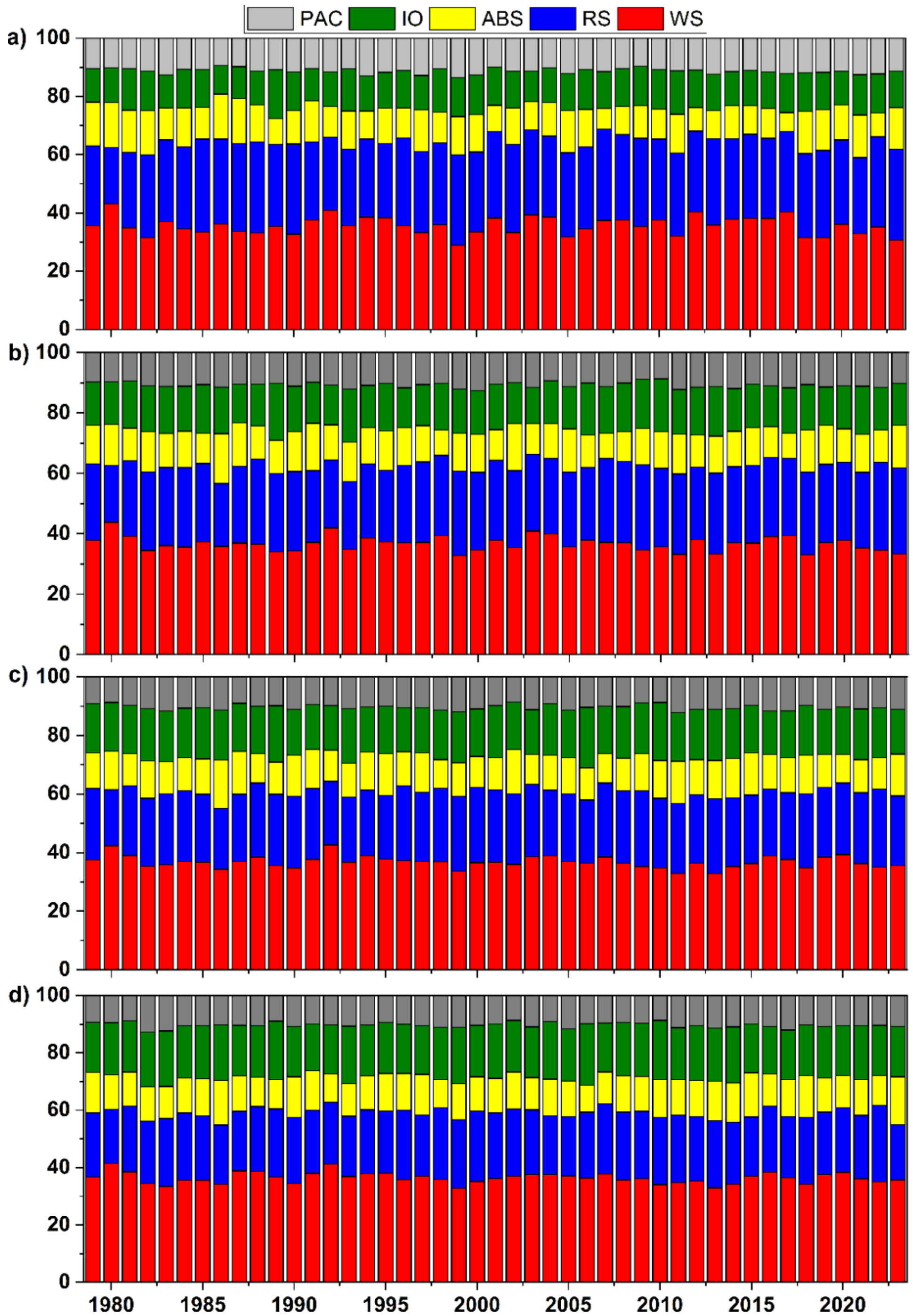
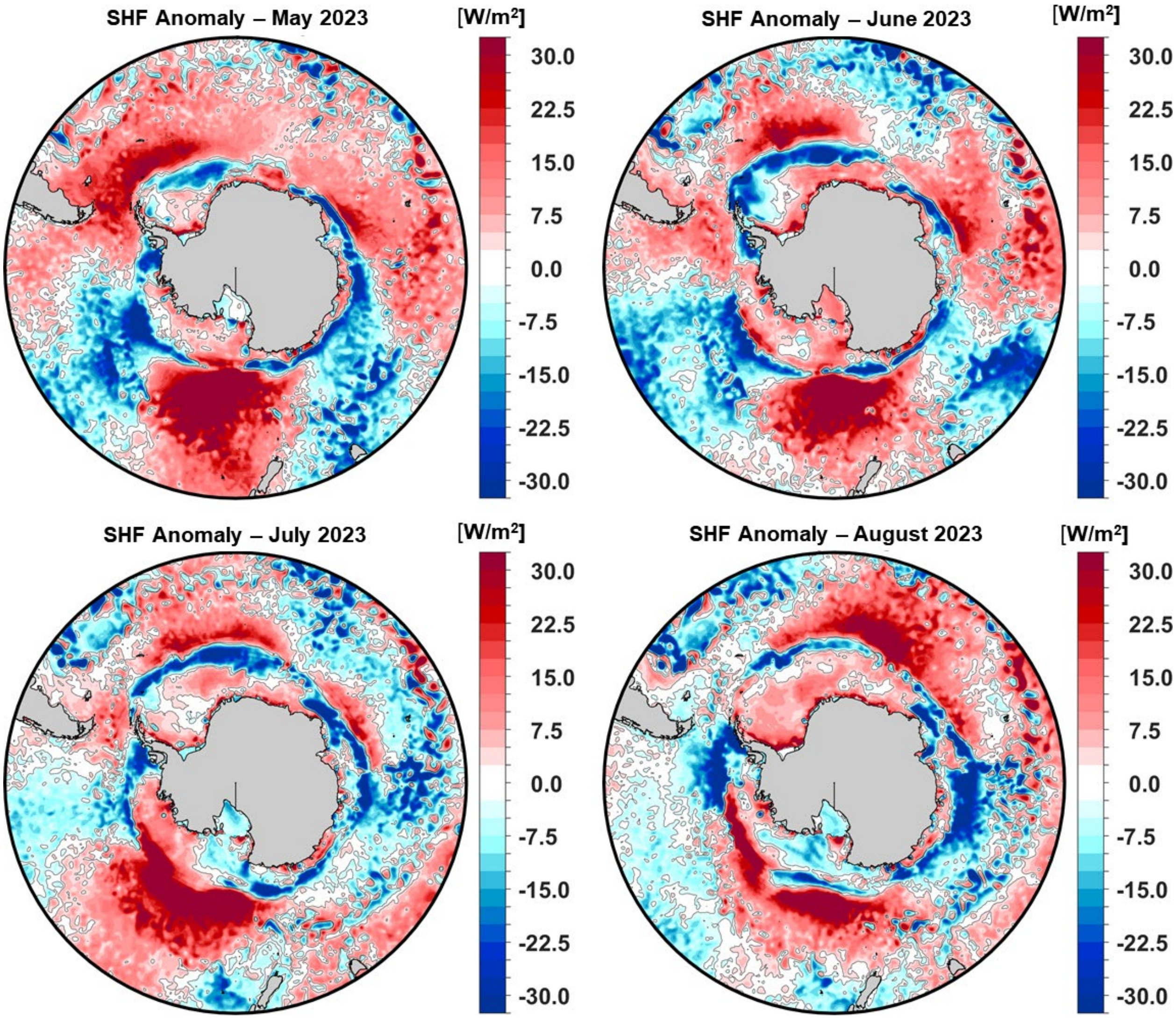
1 Supplementary Figures



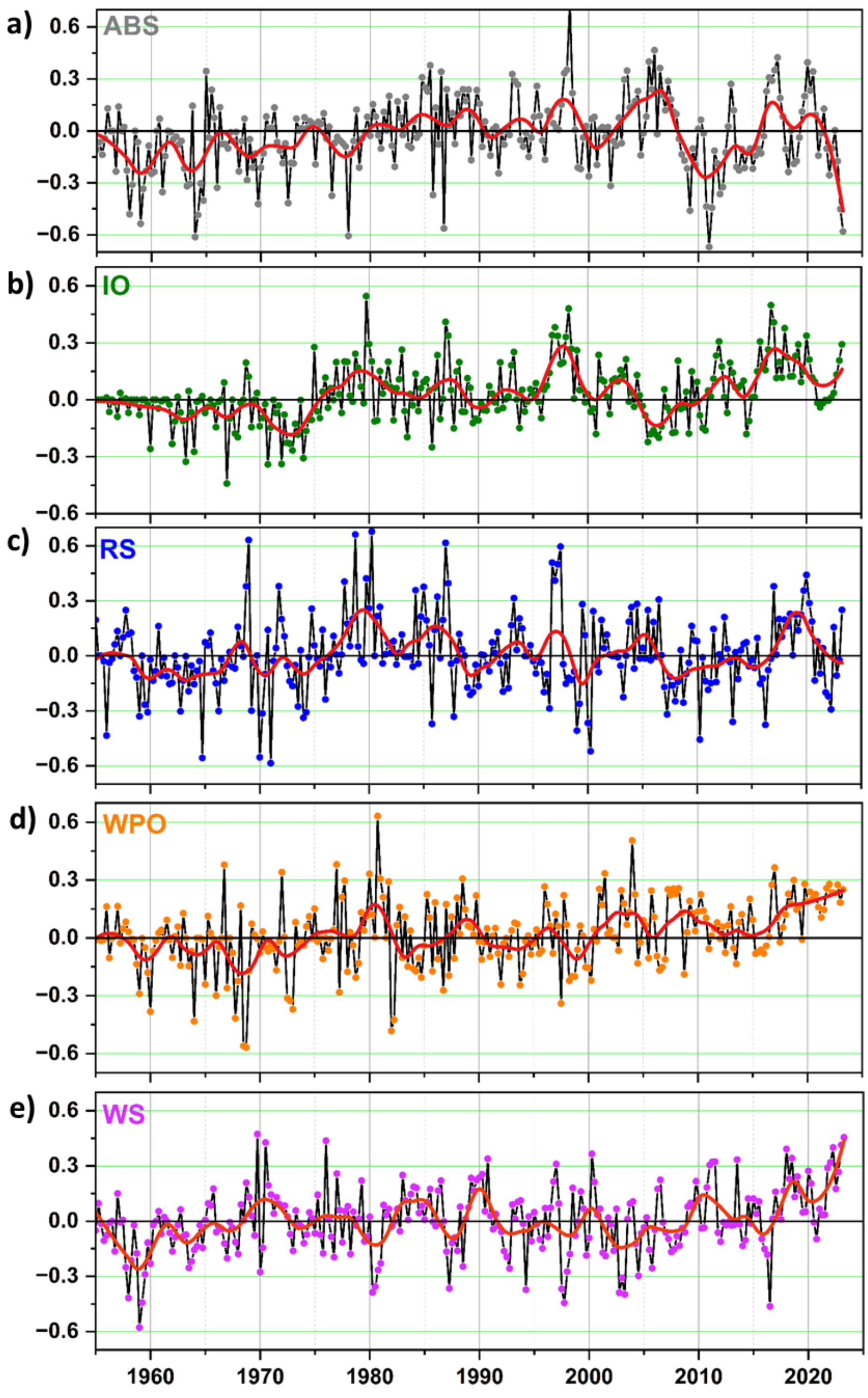
Supplementary Figure 1. a) Daily sea ice extent anomalies for the year 2023 with respect to reference period 1981 - 2010: Amundsen - Bellingshausen Sea (ABS - grey), Indian Ocean (IO - green), Western Pacific Ocean (WPO - orange), Ross Sea (RS - blue) and Weddell Sea (WS - red) and b) Ranking of 2023 regional sea ice extent. In b) 1 means the lowest regional SIE, 2 means the second lowest SIE and so on.



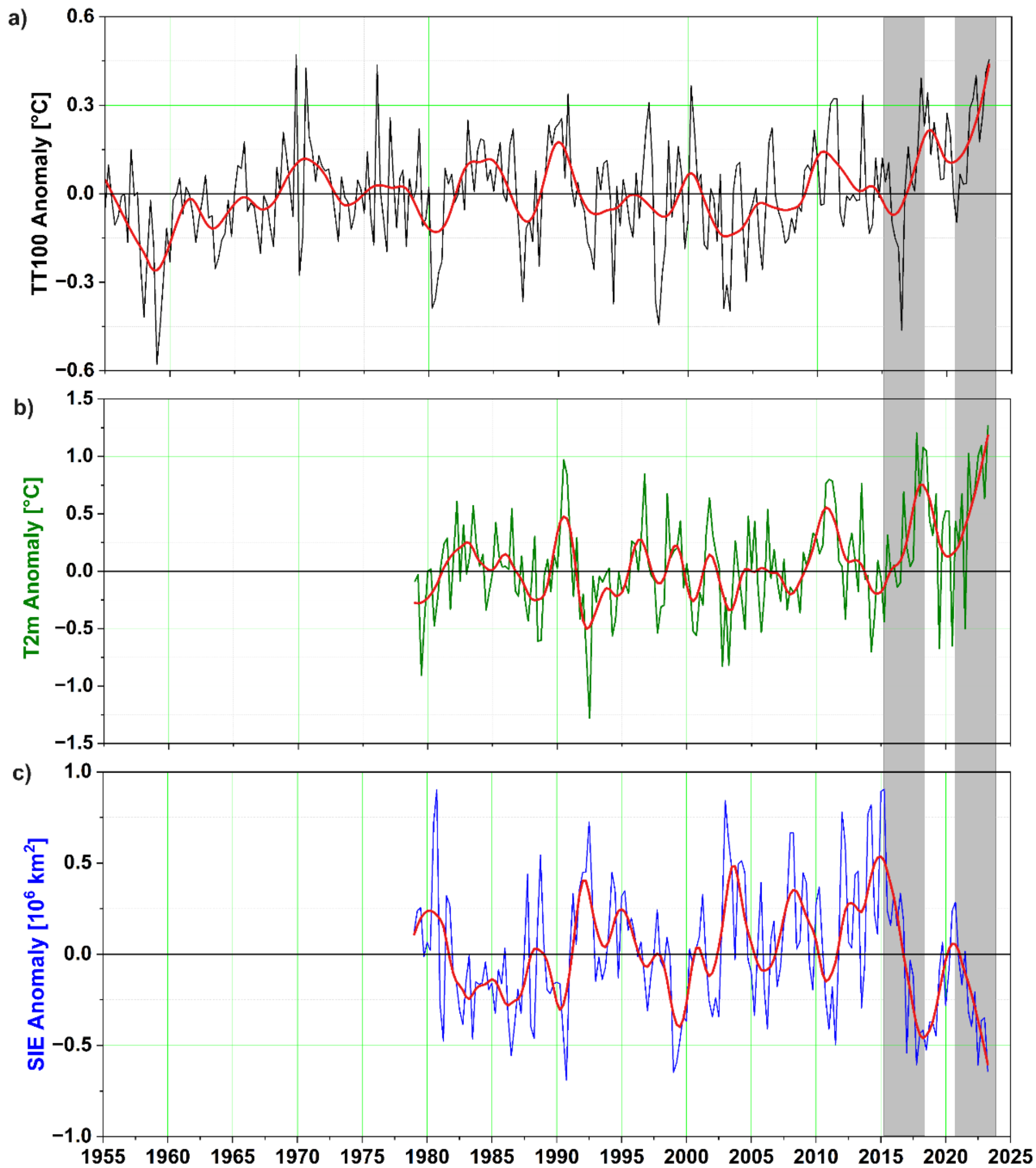
Supplementary Figure 2. Monthly contribution of regional sea ice extent to the hemispheric SIE. A) May; b) June; c) July and d) August. RED – Weddell Sea (WS), BLUE – Ross Sea (RS), YELLOW - Amundsen - Bellingshausen Sea (ABS), GREEN – Indian Ocean (IO) and GREY - Western Pacific Ocean (WPO). Units: [%].



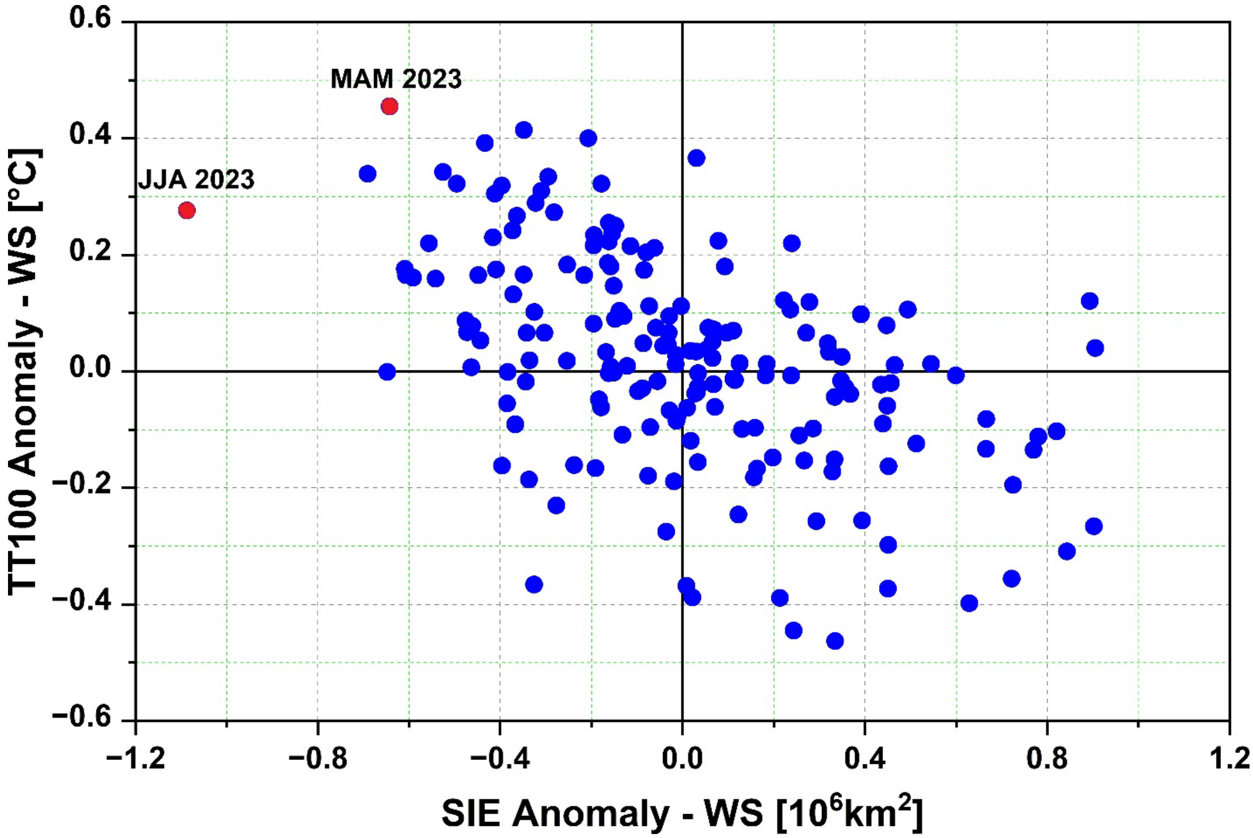
Supplementary Figure 3. Surface sensible heat flux anomalies from May until August 2023. The anomalies are computed relative to the reference period 1981–2010. Units: [W/m^2].



Supplementary Figure 4. Temporal evolution of the seasonally averaged subsurface temperature in the upper 100m over five regions: a) ABS; b) IO; c) RS; d) WPO and e) WS. The red line in a) – e) indicates the low-pass filter (i.e., loess)



Supplementary Figure 5. a) The temporal evolution of the seasonally averaged subsurface temperature anomalies in the upper 100m over WS; b) as in a) but for the seasonal 2m mean air temperature (T2m) anomaly over WS and c) as in a) but for the seasonal sea ice extent (SIE) anomaly over the WS. The red line in a) – c) indicates the low-pass filter (i.e., loess). The correlation coefficients between the 3 time series, over the period 1979 – 2023, are: r [TT100:SIE] = -0.51 (**-0.61**) ($p<0.01$), r[TT100:T2m] = 0.60 **(0.80)** ($p<0.01$) and r[T2m:SIE] = -0.61 (**-0.70**) ($p<0.01$). The bolded number indicate the correlation coefficients for the smoothed time series.



Supplementary Figure 6. Scatter plot of the seasonal sea ice extent (SIE) anomalies and the averaged subsurface temperature in the upper 100m (TT100) over WS. The anomaly in 2023 are highlighted in red. MAM indicates the mean over the months of March – April – May and JJA indicated the mean over the month June – July – August.